

November 19, 1956

SAPC 11309
COPY 2 OF 2

George:

The following is an outline of the history of the "C" Configuration design.

<u>Date</u>	<u>Subject</u>
<u>3/30/55</u>	Letter from JGB to RMS containing tentative design for a 144" f/16, 13 x 13 format "C" systems.
<u>4/18/55</u>	Technical specifications #9 issued to Engineering Department outlining requirements for optical system, resolutions, scanning angle ($\pm 80^\circ$ obliquity).
<u>5/3/55</u>	Tentative design established by Engineering Department and layouts made.
<u>5/14/55</u>	Letter from WAS outlining analysis on IMC rates for "C" Configuration.
<u>5/23/55</u>	Information received from WAS on spooling requirements (direction of supply and take up) for "C".
<u>6/16/55</u>	Memo to Engineering Department reducing obliquity angle to $\pm 65^\circ$ as result of design work by WAS.
<u>6/24/55</u>	Letter from WAS coordinating rocking mirror design, focal plane shutter at first image plane, primary mirror location, IMC, stereo design parameters.
<u>6/28/55</u>	Letter to WAS warning of JGB design change to provide space for rocking mirror. Sketch enclosed showing tentative 144" system per discussion of 6/27/55 between RMS and JGB.
<u>7/11/55</u>	Letter from JGB containing tentative design of 120" f/10.9, 13 x 13 format "C" system. Difficulties encountered in need for aspheric field flattener in space reserved for focal plane shutter in field lens group.
<u>8/10/55</u>	Letter from JGB on field flattener problem and requesting space that can be allotted. JGB starting trip to Europe 120" f/10 design to catalog indices furnished.
<u>8/12/55</u>	Letter to WAS containing copy of JGB's 120" design of 8/14/55.
<u>9/13/55</u>	JGB cut short his European trip and discussed problems of 120" design with RMS. Stop order to Engineering Department issued on this week until new design available. WAS informed of this action by letter dated 9/13/55.
<u>10/1/55</u>	Boston meeting. Decision made to use 180" based upon use of Land's high speed film (Note: use of this film never followed up).
<u>11/17/55</u>	Letter from WAS reviewing design and manufacturing activities with view to minimizing lost time due to stop order and receipt of new "C" design. WAS continuing work on Film Drive, Cassettes and Spools, Programmer and Electrical System, Data Chamber and Gimbal Mount.
<u>12/20/55</u>	Letter from JGB containing preliminary design for 180" f/13.8, 13 x 13 format.
<u>12/29/55</u>	Copy of JGB's letter of 12/20/55 (180" design) given to WAS.
<u>12/30/55</u>	Letter from WAS analyzing frame cycling, overlap and stereo for 180" system.
<u>2/2/56</u>	Coordination of window design with EFM and WAS.
<u>2/27/56</u>	Letter from WAS/FR coordinating shutter design and optical layout with its folding scheme.
<u>3/23/56</u>	Letter to EFM on final design for "C" Configuration windows.
<u>4/23/56</u>	Letter from JGB containing field lens design to catalog indices.
<u>5/14/56</u>	Final malt design on 180" system furnished by JGB.
<u>11/9/56</u>	Delivered 180" glass to Hycon for installation in camera that week.

DOCUMENT NO. _____
 NO CHANGE IN CLASS. ☐
 DECLASSIFIED
 CLASS. CHANGED TO: TS ☒
 REVIEW DATE: 8/5/81
 REVIEWER: _____

- 2 -

25X1

25X1 The key dates have been underlined for rapid reference. Our key productions expeditor [] and an assistant [] spent the month of September 1956 at Hycon assisting them in scheduling "C" Configuration work. During September and October we figured (i.e. polished) and corrected the aspheric surfaces of the glass and tested the optical system. As a first system the work on correcting each of the four aspherics proceeded more slowly than anticipated as an error at this time would have been fatal. We ran into three technical problems during this period which have resulted in design changes for succeeding systems.

The first problem was the discovery by Hycon that a vehicle structural member interfered in the allocated space. Its effect was to require the removal of additional glass from one of the plane mirrors used to fold the optical path. This mirror had been completed and now required that it be repolished to achieve again the required surface tolerance destroyed by the additional grinding. Succeeding mirrors have been redesigned to eliminate this interference. This has required, however, the removal of some glass in the clear aperture with a consequent loss of light (approximately 3% to 5%).

The second problem involved the figuring of the surface on the scanning mirror. This mirror is elliptical with a central hole which poses some unique polishing problems. Experience gained on this mirror has resulted in a production procedure which will assist us in succeeding systems.

The last, and most difficult problem, lay in the mounting method for the spherical, primary mirror of the system which forms the image to be projected to the final focal plane. After two trial and error methods had been tried we arrived at a method which would support this mirror without strain. Since we were faced with a modification of an original design, not having time to remake all pieces, the fix is not ideal.

Flight tests will demonstrate the advisability of retaining it or supplying a replacement. Parallel with this problem was the need to provide additional, mechanical clearance at the bottom edge of the primary mirror. As the system design firmed clearance tolerances got smaller until they reached the point where the original clearances were only half of the design objective. Coordination work with Hycon has been initiated and succeeding systems will have a safe operating margin for clearance in this area.

All the glass was shipped to Hycon on November 9, 1956 for installation at Hycon. One of our engineers [] accompanied the shipment.

25X1

Parallel with the work on the "C" Configuration has been the work on the contractual changes required in Hycon's subcontract to reflect the various changes in the "C" Configuration from a 144" to 120" to 120" system. Per our conference of November 1, 1956, Hycon is preparing a statement of the work involved by the changes. It was proposed that the subcontract would be amended as follows, with prices to be furnished at that time:

<u>Item No.</u>	<u>Description</u>	<u>Current Price</u>	<u>Tentative Proposed New Price</u>	<u>Change</u>	<u>Remarks</u>
112	Prototype				Revise this item description.
113	4 Production Units				Delete and write new item no.
114	Prototype tests				Delete and write new item no.
115	Production tests (4 units)				Delete and write new item no.
116	25 Spare Cassettes				Delete and write new item no.
117	216 Spare Spools				Revise this item (Nyeen to correct billing already submitted)
118	15 Spare Shutters				Delete and write new item no.
119	1st Shipping Container				Delete and write new item no.
120	4 Shipping Containers				Delete and write new item no.
121	1 Sub-assembly				Delete and write new item no.
xxx	Design Phase II				New item to be written as "Redesign 14 to 180" syst

25X1

Total increase

TWM:hm
cc: WAS

DOCUMENT NO. _____
 NO CHANGE IN CLASS. (1)
 DECLASSIFIED
 CLASS. CHANGED TO: TS (S) 2011
 NEXT REVIEW DATE: _____
 AUTH: HR 70-2
 DATE: 8/5/81 REVIEWER: _____

Date	Mission	Config.	Location	Conditions S-Shutter f-stop Filter Article Purpose	% Take	% Release	% OK	% Bad	% None	Quality Max. Average Excellent Very Good Fair Poor	Due To Vibration Camera Shake Motion Vib. Image Motion Exposure Weather	Remarks T - TWR Report M - Mission Report A - Take Analysis
12-21-56	PTF-	C #1	Test Site	S-1/150 F-13.85 Filter Y	100%	100%	100%	0%	None	None	None	(M) Shutter inoperative. Film drive O.K. Probably due to AC switch not on. Cagey relay burned out.
1-29-57	PTF-177	C #1	Test Site	S-1/150 F-13.85 Filter Y Vertical, Fixed IMC	28% Shorted out circuit breaker.	100%	100%	0%	None	None	None	(M) Pilot failed to turn on 400 cycle, 3 pha power to the unit. Therefore, gyros and shutter did not function. Unit advanced film approximately 1150 feet prior to tension sensor switch (star board tight film) failure which shorted out circuit breaker and stop film drive. No exposed film.
1-31-57	PTF-178	C #1	Test Site	S-1/150 F-13.85 Filter Y Vertical, 12 mr/sec IMC	100%	100%	100%	100%	100%	Poor	Movement Focus	(M) All equipment operated O.K. Radio noise frost on corners of windows. Photos had considerable tilt to image. Image motion on 55 frames. Best focus in corner of format.
2-12-57	PTF-182	C #1	Test Site	S-1/150 F-13.85 Filter Y Vertical, 12 mr/sec IMC image flattened and gr. focus.	100%	100%	100%	98% Irregular double ex- posure.	100%	Poor	Movement Focus	(M) All equipment operated satisfactorily. Negatives were considerably out of focus. Movement on 35% of frames.
2-16-57	PTF-183	C #1	Test Site	S-1/150 F-13.85 Filter Y	5% Film wrapped around metering roller.	100%	100%	100%	5%	None	None	(M) Film drive jammed due to film left in camera for two days causing film to adhere to metering roller. Circuit breaker released.

Date	Mission	Config.	Location	Condition	Film	Oblique	Pro-	gauge	Shutter	Photo	Degradation	Comments
				S-Shutter Speed f-stop Filter Article Purpose						Quality	Due To	
									% Take	Max. Average Excellent Very Good Fair Poor	V. Vacuum C. Condition M-A. C Motion Vib. Image Motion P. Process W. Weather	T - TWX Report M - Mission Report A - Take Analysis
7-19-56	PTF-193	C #2	Test Site	S-1/500 F-13.85 Filter Y	100%	100%	100%	100%	100%	Poor	Focus Vibration	(M) Configuration operated modes 1,2,3. All material was transported. Focus appeared approx. 1/4 inch in front of platen. Frames show a considerable amount of vibration.
8-3-57	PTF-195A	C #2	Test Site	S-1/500 F-13.85 Filter Y	100%	100%	100%	100%	100%	Poor	Focus Vibration	(M) Configuration operated mechanically & electrically 100%. Image in front of platen approximately .050, also image movement.
8-3-57	PTF-195B	C #2	Test Site	S-1/300 F-13.85 Filter Y	100%	100%	100%	100%	100%	Fair	Focus Image Move- ment	(M) Configuration operated mechanically & electrically 100%. Focus was better than previous mission PTF-195A. There is still image movement, cause still being determined.
10-8-57	PTF-206	C #2	Test Site	S-1/250 F-15° Filter Y	100%	100%	100%	100%	100%	Fair	Focus	(M) Configuration operated mechanically & electrically 100%. Focus appeared to be the same over the entire platen. Frames view do not show any image movement.
	PTF-209	C #2	T.S.		75% (MicroSwitch)	100%	100%	100%	100%	Poor	Focus	
11-1-57	PTF-213	C #2	T.S.									

MECHANICAL AND ELECTRICAL OPERATION

Date	Mission	Config.	Location	Conditions	Approved For Release 2004/05/13 : CIA-RDP89B00980R000400090011-0					Quality	Degradation Due To	Comments
					Transport	Drive	grammar	Shutter	Other			
				S-Shutter Speed f-stop Filter Article Purpose					% Take	Max. Average Excellent Very Good Fair Poor	Max. Accum. Motion M-A/C VIB. Image Motion C-Process W-Weather	T - TWX Report M - Mission Report A - Take Analysis
3-3-57	PTF-184	C #1	Test Site	S-1/150 F-13.85 Filter Y Vertical, 12 mr/sec Tilted platen test.	100%	100%	100%	100%	100%	Poor	Movement Focus	(M) All equipment operated satisfactorily. Best focus at edge of format. 52° to 72° temperature of optics. Uneven exposure.
3-5-57	PTF-185	C #1	Test Site	S-1/1200 F-13.85 Filter Y Vertical, 12 mr/sec IMC tilted platen test	100%	100%	100%	99.8% Shutter Failure	99.8%	Poor	Movement Vibration Focus uneven exposure.	(M) All equipment operated satisfactorily. Shock movement in 136 frames. 13 frames image motion, 3 frames shutter failure. Uneven exposure. Best focus in center of format.
3-6-57	PTF-186	C #1	Test Site	S-1/200 F-13.85 Filter Y Vertical, 12 mr/sec IMC, flat platen focus for aerial focus.	100%	100%	100%	99.5%	99.5%	Poor	Shock movement. Image motion. Uneven exposure.	(M) All equipment operated satisfactorily. 400 frames had shock movement. 16 frames had image motion. 7 frames had shutter failure. Radio noise. Image not fully square on with platen. Uneven exposure.
3-26-57	PTF-187	C #1	Test Site	S-1/200 F-13.85 Filter Y Mode 2. Operation, 12 mr/sec IMC, flat platen.	100%	95% Oblique drive motor burned out near end of flight.	100%	100%	100%	Fair	Image motion focus	(M) At conclusion of flight power was turned off causing current surge thru film drive servo, burning out condenser. Oblique drive motor was also burned out near end of flight due to insulation burning through (external) and shorting out field winding. Oblique tracking was good. Image not fully squared on with platen. Uniform exposure. Temp. 36° - 56° (using mercury thermometer) Eight hours flight. Film failed to advance on one frame. Double exposure on one frame. Shutter failure on one frame. Image motion on 6 frames.

Date	Mission	Config.	Location	Condition	Approved For Release 2004/05/13 : CIA-RDP89B00980R000400090001-0	Film	Oblique	Pro-	Shutter	Other	Quality	Degradation Due To	Comments
				S-Shutter f-stop Filter Article Purpose						% Take	Max Average Excellent Very Good Fair Poor	V-Vacuum M-A/C VIB-Image P-Process W-Weather	
4-26-57	PTF-188	C #1	Test Site	S-1/200 F-13.85 Filter Y Resolution test with the new primary mirror. Mode 2 & 3 test. Tilted pla- ten.	100%	100%	100%	0%	0%	0%	None	None	(M) Configuration transported film but a circuit breaker opened during warm up period and shutter did not trip. Lens heat incorrectly wired to captivator circuits causing circuit breaker to open. Operation at K-5. No. photo results.
4-30-57	PTF-189	C #1	Test Site	S-1/200 F-13.85 Filter Y Resolution test with tilted pla- ten and new pri- mary mir- ror Mode 2 & 3.	100%	100%	100%	100%	100%	100%	Poor	Vibration	(M) Captivator inoperative due to lens heater shorting out circuit. Photo quality poor due to being taken incaged position. Turbulent air at K-5.
5-3-57	PTF-190	C #1	Test Site	S-1/500 F-13.85 Filter Y Resolution test with tilted pla- ten and new pri- mary mir- ror mode 2 & 3. Temp. & gyro in- strumen- tation	100%	100%	100%	100%	100%	100%	Fair	Focus	(M) Operation at K-5. Photographic resul good. 15 to 18 lines at best image area. AC frequency probably much too low as noted from instrumentation lens. Temp. constant at 71° F. B.F.L. change is 1/4 Cager motor pin sheared

Modifications of C Config. - Optical System
Prior to Photo Test Flights
PECO

- I Remount Primary and G mirrors to reduce sensitivity of mirrors to vibration. This modification should include a check of the mirrors in the optical system to determine whether or not revised mount tends to distort mirror.
- II Recheck and re-align two 300" collimators - one at Hycon and one at test site. These collimators should be modified such that they are of a quality equal that of the collimator now in use at P.E.
- III Final alignment of the second optical system should be made at the test site as part of the pre-flight check out.
- IV Temperature test of optical system. If possible, further temperature test should be conducted on the #2 optical system.

C. G. G.

Proposed Modifications, Configuration C
Required Before Next Photo Test Flight
-Hycon-

- I. Install three-axis position servo to eliminate mechanical caging during photographic run. The three axis servo has been designed and tested through the breadboard stage. Work required involves assembly of servo to one configuration and necessary tests.
- II. Modify caging system so that cager motor will be off during photographic operations. At present the cager motor is running during camera operation. This modification involves a partial redesign of mechanics and circuitry of existing cager.
- III. Isolate configuration from aircraft vibration and investigate placing isolators at configuration mounting points rather than at gimbal. To avoid placing a second pivot point in the stabilization system, it is desirable to place a set of isolators at the configuration mounting. Within the time allotted it may be impossible to make this great a modification.
- IV. Stiffen torquer solenoid brackets. Existing solenoid brackets have too much compliance and will have to be stiffened.
- V. Support the shutter and gyro block from the superstructure rather than the optic structure. It is contemplated that this modification can be more readily accomplished if five sub-assemblies, programmer, power supply, tension regulator, shutter, and gyro block are mounted together on a framework supported by the superstructure.
- VI. Replace existing HIG-5 gyros with HIG-4's if available for this application HIG-4 gyros are virtually identical to HIG-5's, but HIG-4's have better vibration characteristics. As a further aid to vibration reduction, the brake solenoid will be removed. Original purpose of the brake was to hold the rocking mirror in the oblique position; however, it was found in actual operation that there was enough inherent stiffness in the rocking mirror drive and gearing to hold oblique positions adequately.

ACTIVITY	MONTH	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
PERSONNEL:							
PROJ. MGR. -							
ASSIST. MGR.							
MECH. ENGR.							
ELEC. ENGR.							
OPT. ENGR.							
SR. FIELD ENGR. -							
FIELD ENGR. -							
" " -							
" " -							
" " -							
CONSULTANT -							
PROJ. OFFICE -							
GLASS MANUFACTURING 3							
SYSTEM 2							
SYSTEM 3 (REWORK PROTOTYPE)							
SYSTEM MODIFICATION:							
VIBRATION CONSULTANTS							
ACQUIRE AUDIO & THERMAL DATA							
MODIFY SYSTEM 1 FOR TEST							
FLIGHT TEST SYSTEM 1							
DESIGN FINAL MODIFICATIONS							
DELIVER & TEST SYSTEM 1							
" " " 2							
" " " 3							
FIELD SUPPORT							

PROPOSED PLAN & ACTIVITY - "C" CONFIGURATION

[illegible]

Aug. 1

26 May

Weeks

Item	Tasks	Responsibility	1	2	3	4	5	6	7	8	9	10
I	Airlift all of C#4 to Hycon except Opt. Str.	P. E.										
II	Remount Mirrors	P. E.										
III	Position Servo	Hycon										
IV	Cager Cut-off	Hycon										
V	Aircraft Isolator	Hycon										
VI	Stiffen Solenoid Brackets	Hycon										
VII	Shutter & Gyro Support frame	Hycon										
VIII	Temp. Tests	P. E.										
IX	Rework two 300" Col.	P. E.										
X	Airlift Opt. Str. & collimators to Hycon	P. E.										
XI	Final Assy.	Hycon										
XII	Deliver to EAFB	Hycon										
XIII	Final align. P/E clearance	P. E. & Hycon										
XIV	Prepare for Flight test	P. E. & Hycon										
XV	Engineering Support of Flight test	P. E. & Hycon										
XVI	Evaluate Results	P. E. & Hycon										